
कृत्रिम रेशों से निर्मित टायर सूत, डोरी और
टायर डोरी कपड़ा — परीक्षण के तरीके
भाग 5 ऊष्मा सिकुड़न और सिकुड़न बल
(दूसरा पुनरीक्षण)

**Tyre Yarns, Cords and Tyre Cord
Fabrics Made from Man-Made Fibres
— Methods of Test
Part 5 Heat Shrinkage and Heat
Shrinkage Force
(Second Revision)**

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भारतीय मानक ब्यूरो
BUREAU OF INDIAN STANDARDS
मानक भवन, 9 बहादुर शाह ज़फर मार्ग, नई दिल्ली - 110002
MANAK BHAVAN, 9 BAHADUR SHAH ZAFAR MARG
NEW DELHI - 110002
www.bis.gov.in www.standardsbis.in

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FOREWORD

This Indian Standard (Part 5) (Second Revision) was adopted by the Bureau of Indian Standards, after the draft finalized by the Technical Textiles for Mobiltech Applications Sectional Committee had been approved by the Textiles Division Council.

This standard was first published in 1970 and subsequently revised in 1989. The second revision has been made in the light of experience gained since its last revision and to incorporate the following major changes:

- a) The title of the standard has been modified;
- b) The pre-tension used during the determination of heat shrinkage has been modified; and
- c) The new method of test for determination of heat shrinkage is given in Annex B.

This standard has been published in various parts. The other parts under this series are:

- Part 1 Definition of terms
- Part 2 Linear density
- Part 3 Load and elongation characteristics
- Part 4 Dip pick-up
- Part 6 Wet contraction and wet contractile force
- Part 7 Heat degradation
- Part 8 Thickness
- Part 9 Sampling of tyre yarns, cords and tyre cord fabrics made from rayon
- Part 10 Creep
- Part 11 Commercial mass
- Part 12 Sampling of tyre yarns, cords and tyre cord fabrics made from polyamide
- Part 13 Static Adhesion of textile tyre cord to vulcanized rubber

The composition of the committee responsible for the formulation of this standard is listed in Annex C.

In reporting the result of a test or analysis made in accordance with this standard, if the final value, observed or calculated, is to be rounded off, it shall be done in accordance with IS 2 : 2022 'Rules for rounding off numerical values (*second revision*)'.

*Indian Standard***TYRE YARNS, CORDS AND TYRE CORD FABRICS MADE FROM
MAN-MADE FIBRES — METHODS OF TEST****PART 5 HEAT SHRINKAGE AND HEAT SHRINKAGE FORCE***(Second Revision)***1 SCOPE**

This standard (Part 5) prescribes method for determination of heat shrinkage and heat shrinkage force developed in man-made fibre tyre yarns and cords when exposed to elevated temperature under a standard pre-tension of 5 mN/tex \pm 1 mN/tex. This standard is applicable to man-made fibre tyre yarns and cords taken from cheeses, cones, bobbins, spools or tyre cord fabrics. In case of tyre cord fabrics, the cords shall be removed from the tyre fabrics for testing.

NOTE — In case of yarn/cord range from 200 dtex to 7 000 dtex (180 denier to 6 300 denier), the method given in Annex B may be followed if agreed to between the concerned parties.

2 REFERENCES

The standards listed in Annex A contain provisions which through reference in this text, constitute provisions of this standard. At the time of publication, the editions indicated were valid. All standards are subject to revision and parties to agreements based on this standard are encouraged to investigate the possibility of applying the most recent editions of the standards listed in Annex A.

3 SAMPLING

Samples from the lot shall be drawn so as to be representative of the lot. Sample drawn in accordance with the procedure laid down in the relevant material specification or as agreed to between the buyer and the seller shall be held to be representative of the lot.

4 CONDITIONING OF TEST SAMPLE

Unless otherwise agreed to between the buyer and the seller, the test sample shall be conditioned to a state of moisture equilibrium from the dry side in standard atmosphere as prescribed in IS 6359.

NOTE — When a test sample under zero tension has often left in such a way as to expose, as far as possible, all portions of it to the standard atmosphere for 24 h, the test sample shall be deemed to have reached a state of moisture equilibrium.

5 APPARATUS**5.1 Mounting Device**

The device shall be such that a test specimen of at least 250 mm length can be mounted on it with one of its ends in a fixed clamp under desired dead weight tension

and exposed to a temperature of 150 °C \pm 2 °C, 160 °C \pm 2 °C or 175 °C \pm 2 °C as the case may be. It shall be provided with means for:

- a) measuring the heat shrinkage percentage directly or the initial and final lengths of test specimen to an accuracy of 1 mm during exposure to a high temperature in case of heat shrinkage test; and
- b) attaching one clamp to a strain gauge or mechanical device capable of indicating tension to an accuracy of 1 g without any significant changes in the length of the specimen in case of heat shrinkage force test.

6 PROCEDURE

6.1 Mount the conditioned test specimen on the mounting device under a standard pre-tension of 5 mN/tex \pm 1 mN/tex. Note the original length of the test specimen for heat shrinkage test and initial tension in the case of heat shrinkage force test.

6.2 Expose the test specimen as mounted above to a temperature of 150 °C \pm 20 °C, 160 °C \pm 2 °C or 175 °C \pm 2 °C (as agreed to between the parties) and keep it in this position until change in shrinkage/shrinkage force in the test specimen in 1 min interval is not more than 5 percent. Note the final length or force, as the case may be, while the specimen is still exposed to higher temperature.

6.3 Take at least 5 readings.

6.4 Calculate the heat shrinkage and heat shrinkage force as follows:

$$\text{a) Heat shrinkage, percent} = \frac{a-b}{a} \times 100$$

where

a = original length of the specimen, and

b = final length of the specimen.

$$\text{b) Heat shrinkage force in mN/tex} = \frac{f_1 - f_2}{t}$$

where

f_1 = final tension in mN developed in the specimen,

f_2 = initial tension in mN in the specimen, and

t = linear density of tyre yarn or cord in tex.

7 REPORT

7.1 The report shall include the following information:

- a) Type of material;
- b) Elevated temperature used;
- c) Heat shrinkage;
- d) Heat shrinkage force;
- e) Number of tests; and
- f) Temperature used for conditioning that is, 27 °C
± 2 °C.

ANNEX A
(Clause 2)
LIST OF REFERRED STANDARDS

<i>IS No .</i>	<i>Title</i>
IS 6359 : 1971	Method for conditioning of textiles.

ANNEX B

(Clause 1, Note)

METHOD FOR DETERMINATION OF DRY HOT AIR THERMAL SHRINKAGE OF TYRE CORD YARN USING AN AUTOMATIC THERMAL SHRINKAGE HOT CHAMBER /OVEN

B-1 SCOPE

B-1.1 This test method covers the measurement of shrinkage of yarn and cords when exposed in a thermal shrinkage hot chamber/oven.

B-1.2 This test method is applicable to yarns and cords made of nylon, polyester, and other polymers not detrimentally affected by the temperature used.

B-1.3 This test method is applicable to linear densities in the range from 200 dtex to 7 000 dtex (180 denier to 6 300 denier).

B-1.4 Yarns or cords for testing may be taken from yarn packages or from fabric.

B-2 PRINCIPLE

B-2.1 A specimen of yarn/cord is subjected to dry heat for a specified time while under a specified pre-tension. The percent shrinkage is read directly from a computer terminal display attached on the instrument while the specimen is still under tension and exposed to heat.

NOTE — An effective draft shield is available on to the thermal chamber or oven (*see* Fig. 1). This is very important because the chamber in which the specimen is heated is open on three sides, air drafts can effectively alter the length of specimen experiencing the prescribed temperature.

B-3 APPARATUS

B-3.1 Thermal Shrinkage Hot Chamber/ Oven —
Capability to control the temperature upto 180 °C.

B-3.2 Stopwatch or Timer

B-3.3 Clip-on Masses

B-4 Testing Sample

B-4.1 For yarns, strip at least 25 m from the outside of each package in the laboratory sampling unit.

B-4.2 Inspect the outside of the package after stripping off the yarn. If there is visible damage, continue to strip off units of 25 m and re-inspect until there is no visible damage. Take one specimen and put into the clips of hot chamber. The specimen length will automatically get adjusted to 500 mm to 600 mm as per requirement, as this is the initial distance between the fixed clamp to the movable pulley. Discard and replace specimens that are visibly damaged.

B-5 Test Procedure

B-5.1 With the draft shield in place, preheat the oven until the chamber has attained the specified temperature for a period of 5 min. Set the oven temperature controller set point to give a specimen temperature as given in Table 1 or agreed between the buyer and seller.

B-5.2 For yarns or cords possessing low levels of shrinkage force, a tension loading 1.0 mN/tex \pm 0.2 mN/tex may be used. In case of lower tension, it should be mentioned in the report.

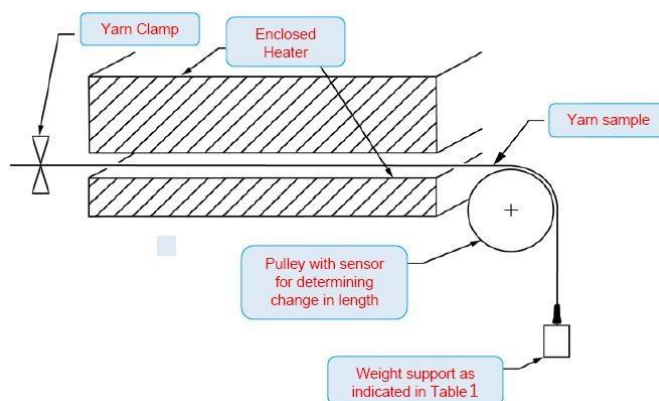


FIG. 1 OPERATIONAL PRINCIPLE OF THERMAL SHRINKAGE HOT CHAMBER/OVEN

Table 1 Requirements of Mass and Temperature for Different Yarn Densities.
(Clause B-5.1)

Sl No.	Temperature, °C	Tensioning mass, mN/tex	Time, s	
			Linear Density (up to 400 tex)	Linear Density (above 400 tex)
(1)	(2)	(3)	(4)	(5)
i)	175 ± 2	5.0 ± 1.0	120 ± 10	240 ± 10
ii)	160 ± 2	5.0 ± 1.0	120 ± 10	240 ± 10

B-5.3 Install one end of the specimen in the fixed clamp.

B-5.4 Bring the other end of the specimen over the pulley. Set the indicator to zero and hold it on zero while performing the next step.

B-5.5 Attach a clip-on mass to unclamped end of specimen so that twist is not lost. Use a mass that creates a tension load as 5.0 mN/tex ± 1.0 mN/tex or as agreed between buyer and seller.

B-5.6 Load specimen into the oven/chamber.

B-5.7 The draft shield will automatically come into place or close manually before starting the test. Start the timer at the moment the draft shield closed.

B-5.8 Once the set time reaches (alarm indication) read

the percent shrinkage as indicated to the nearest 0.1 percent.

B-5.9 Remove and discard the specimen.

B-5.10 The test time may vary depending on agreement between buyer and seller (*see* Table 1). A few specific applications may require test time of 900 s (15 min).

B-5.11 The required test temperature is generally in the range 150 °C to 180 °C.

B-6 RESULTS

The shrinkage value is directly displayed on the screen. The shrinkage is the difference between the initial specimen length and final length expressed as a percentage (*see* 6.4).

ANNEX C
(Foreword)

COMMITTEE COMPOSITION

Technical Textiles for Mobiltech Sectional Committee, TXD 38

<i>Organization</i>	<i>Representative(s)</i>
Northern India Textile Research Association, Ghaziabad	DR M. S. PARMAR (<i>Chairperson</i>)
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Federation of Indian Chambers of Commerce and Industry, New Delhi	SHRI TUSHAR PATEL SHRI MAHENDRA HADA (<i>Alternate</i>)
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Indian Technical Textile Association, Mumbai	DR ANUP RAKSHIT SHRI ANKIT DESAI (<i>Alternate</i>)
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Organization

BIS Directorate General

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Member Secretary

SHRI BANOTHU RANGA
SCIENTIST 'B' / ASSISTANT DIRECTOR
(TEXTILES), BIS

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BUREAU OF INDIAN STANDARDS

Headquarters:

Manak Bhavan, 9 Bahadur Shah Zafar Marg, New Delhi 110002
Telephones: 2323 0131, 2323 3375, 2323 9402

Website: www.bis.gov.in

Regional Offices:

	Telephones
Central : 601/A, Konnectus Tower -1, 6 th Floor, DMRC Building, Bhavbhuti Marg, New Delhi 110002	{ 2323 7617
Eastern : 8 th Floor, Plot No 7/7 & 7/8, CP Block, Sector V, Salt Lake, Kolkata, West Bengal 700091	{ 2367 0012 2320 9474
Northern : Plot No. 4-A, Sector 27-B, Madhya Marg, Chandigarh 160019	{ 265 9930
Southern : C.I.T. Campus, IV Cross Road, Taramani, Chennai 600113	{ 2254 1442 2254 1216
Western : Plot No. E-9, Road No.-8, MIDC, Andheri (East), Mumbai 400093	{ 2821 8093

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